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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/775,145

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Toshihiro Hayami

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EXAMINER

ARANCIBIA, MAUREEN GRAMAGLIA

ART UNIT

PAPER NUMBER

1763

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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3 MONTHS

03/01/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/775,145	Applicant(s) HAYAMI ET AL.	
	Examiner Maureen G. Arancibia	Art Unit 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 and 11-24 is/are pending in the application.
- 4a) Of the above claim(s) 2 and 12 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 11-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 November 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. **Claims 19 and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

Claims 19 and 22 each recite the limitation "the filter" in Line 1. There is insufficient antecedent basis for this limitation in the claim. For the purposes of the following examination on the merits, Claim 19 has been treated as being dependent on Claim 4, and Claim 22 has been treated as being dependent on Claim 14.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. **Claims 1, 7-9, 11, and 18 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,210,466 to Collins et al.**

In regards to Claims 1, 8 and 11, Collins et al. teaches a plasma processing unit comprising: a processing container 12 whose pressure can be reduced by a pump 17; first and second electrodes 32C, 27 arranged in the processing container; a process gas supplying unit 19 that supplies a process gas into the processing container; a

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tubular supporting part 32O that supports the first electrode 32C as broadly recited in the claims, the tubular supporting part forming a space together with the first electrode, and a high-frequency electric power supplying part at least partially arranged in the space, as broadly recited in the claims. (Current flows along the tubular member 32O and electrode 32C within the space; Column 7, Lines 15-43.) The high-frequency electric power supplying part further includes a first high-frequency electric power source 30 that outputs first high-frequency electric power having a first frequency in the VHF band (Column 6, Lines 17-22); a first matching unit 31 for impedance matching of the first frequency; and a transmission line that transmits the first high-frequency electric power from the source to the matching unit. (Figure 1) The first high-frequency electric power transmitted to the first electrode is adapted to generate plasma in such a manner that the substrate 15 to be processed can undergo a plasma process by means of the plasma. (Column 4, Lines 25-47)

In regards to Claims 7 and 18, Collins et al. teaches that the first frequency can be 50 to 800 MHz (Column 4, Lines 35-39), which overlaps with the range of greater than 70 MHz recited in the claims, and therefore meets the limitation.

In regards to Claim 9, Collins et al. teaches that vent holes 20 are provided in the second electrode 27 to jet out the process gas towards the first electrode 32c holding the substrate 15 to be processed. (Figure 1)

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 3, 6, 13, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al. in view of U.S. Patent 5,643,364 to Zhao et al.

The teachings of Collins et al. were discussed above.

In regards to Claims 3 and 13, Collins et al. does not teach that the length of the transmission line is shorter than $3\lambda/4$, λ being a wavelength of the third harmonic wave of the high-frequency electric power, and with respect to the the third harmonic wave of the high-frequency power, an output terminal of the high-frequency electric power source is an electrically short-circuited end and an input terminal of the matching unit is an electrically open end.

Zhao et al. teaches a plasma processing unit (Figure 2), wherein a transmission line that transmits high-frequency power from high-frequency power generator 12" to processing container 10 is less than one eighth of the wavelength of the high-frequency power signal in length. (Column 3, Line 61 - Column 4, Line 6). Zhao et al. further teaches that when the transmission line is short compared to one quarter of the wavelength of the high-frequency power signal, the matching unit can be connected at either end of the transmission line; i.e. the transmission line in question can run from the high-frequency power generator to the matching unit, or from the matching unit, as part of the high-frequency power generator, to the processing container. (Column 2, Lines 40-44) An output terminal of the high-frequency power source 12 is an electrically

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short-circuited end and an input terminal of the matching unit 30 is an electrically open end. (Figure 2)

It would have been obvious to one of ordinary skill in the art to modify the apparatus taught by Collins et al. to have the length of the transmission line between the power source and the matching unit be less than one eighth of the wavelength of the high-frequency power signal, and to have an output terminal of the high-frequency power source be an electrically short-circuited end and an input terminal of the matching unit be an electrically open end. The motivation for having the length of the transmission line be less than one eighth of the wavelength of the high-frequency power signal, as taught by Zhao et al. (Column 4, Lines 3-11), would have been to allow for the substitution of a relatively inexpensive, compact, reliable fixed matching unit for the conventional variable matching unit, which can be more expensive and less reliable. The motivation to have an output terminal of the high-frequency power source be an electrically short-circuited end and an input terminal of the matching unit be an electrically open end, as taught by Zhao et al. (Column 4, Line 63 - Column 5, Line 9), would have been to allow for the inclusion of comparator circuitry to adjust delivered power as measured at the electrically open end of the matching unit by comparison with a desired power 38, which is illustrated in Figure 2 to be set relative to ground (electrically short circuited end).

Setting the length of the transmission line to be less than one eighth of the wavelength of the high-frequency power signal translates to the length being less than $3\lambda/8$, λ being a wavelength of the third harmonic wave of the high-frequency electric

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power. (The frequency of the third harmonic is three times the frequency of the applied high-frequency power signal, and thus the wavelength of the third harmonic is also three times the wavelength of the applied power signal.) Having the length of the transmission line be less than $3\lambda/8$ meets the limitation that it be less than $3\lambda/4$ (a length where a resonance state of a third harmonic wave of the high-frequency electric power may be generated).

In regards to Claims 6 and 17, Collins et al. does not expressly teach that the transmission line is a coaxial cable.

Zhao et al. teaches that it is conventional to use coaxial cable as an RF transmission line. (Column 1, Lines 24-25 and 38-41)

It would have been obvious to one of ordinary skill in the art to use coaxial cable as the transmission line in the combination of Collins et al. and Zhao et al., as the standard, art-recognized means of transmitting RF power (as taught by Zhao et al., Column 1, Lines 24-25 and 38-41).

7. Claims 4, 5, 14-16, 19, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al. in view of U.S. Patent 6,887,339 to Goodman et al. and U.S. Patent 6,703,080 to Reyzelman et al.

The teachings of Collins et al. were discussed above.

In regards to Claims 4, 14, and 16, Collins et al. does not expressly teach that the high-frequency power generating part generates high-frequency power when DC power is supplied to it, or that the DC power source converts commercial AC power to generate the DC power.

Goodman et al. teaches that a DC power source 114 converts commercial AC power (*line voltage power supply*) to DC power, and supplies the DC power to a high-frequency generating part (*convertor 122*) via a cable. The high-frequency generating part then generates the high-frequency power. (Figure 7; Column 10, Lines 19-42)

It would have been obvious to one of ordinary skill in the art to modify the apparatus of Collins et al. to have the high-frequency power generating part generate high-frequency power when DC power is supplied to it, and to have a DC power source that converts commercial AC power to generate the DC power. The motivation for making these modifications, as taught by Goodman et al. (Column 10, Lines 39-42), would have been that such an arrangement, among other benefits, allows the high-frequency power to be controlled by varying the voltage on the DC convertor.

In regards to Claims 4, 5, 14, 15, 19, and 22, the combination of Collins et al. and Goodman et al. does not expressly teach a filter, having an output terminal connected to the transmission line as an electrically short-circuited end, that selectively allows the high-frequency electric power from the high-frequency power generating part to pass through; or a circulator, connected between the high-frequency generating part and the filter, that allows a forward wave from the high-frequency power generating part to pass through and absorbs a reflected wave from the matching unit.

Reyzelman et al. teaches that a high-frequency power source 14 includes a filter (diplexer comprising low pass filter 52 and high pass filter 58) connected to the transmission line as an electrically short-circuited end (Figure 3B), that selectively allows the high-frequency electric power from the high-frequency power generating part

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to pass through; and a circulator 32, connected between the high-frequency generating part and the filter, that allows a forward wave from the high-frequency power generating part (power indicated at 28) to pass through and absorbs a reflected wave from the matching unit 60. (Figure 3B; Column 7, Lines 13-21; Column 9, Lines 3-30)

It would have been obvious to one of ordinary skill in the art to modify the combination of Collins et al. and Goodman et al. to include a filter and a circulator in the manner taught by Reyzelman et al. The motivation, as taught by Reyzelman et al. (Column 9, Lines 31-34) for including a filter in the manner taught by Reyzelman et al., would have been to decrease the amplitude of reverse signals coming back from the plasma load through the matching unit and reaching the high-frequency power generating part. The motivation, as taught by Reyzelman et al. (Column 13, Line 55 Column 14, Line 3) for including a circulator in the manner taught by Reyzelman et al., would have been to provide isolation and suppression of reflected power caused by interactive plasma impedances that would otherwise degrade stability and reliability of the system.

8. Claims 20 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al. in view of U.S. Patent 6,089,181 to Suemasa et al.

The teachings of Collins et al. were discussed above.

Collins et al. does not expressly teach a second high frequency electric power source and second matching unit for supplying a second electric power to the first electrode.

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Suemasa et al. teaches first and second high frequency power sources 140, 148 are connected to a first electrode via first and second matching units 144, 156, respectively, for supplying two electric powers to the first electrode. (Figure 1)

It would have been obvious to one of ordinary skill in the art to modify the apparatus taught by Collins et al. to include a second high frequency power source and a second matching unit connected to the first electrode, as taught by Suemasa et al. The motivation for doing so, as taught by Suemasa et al. (Column 5, Line 63 - Column 6, Line 57), would have been to supply a superposed RF power to the first electrode, thereby improving plasma etching uniformity and rate.

9. Claims 21 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al. in view of Suemasa et al. as applied to claims 20 and 23 above, and further in view of U.S. Patent 6,242,360 to Fischer et al.

The teachings of Collins et al. and Suemasa et al. were discussed above.

The combination of Collins et al. and Suemasa et al. does not expressly teach that the high-frequency electric power supplying part comprises three vertically stacked boxes, and the first high-frequency electric power source, the first matching unit, and the second matching unit are contained in the three boxes.

Fischer et al. teaches that a high-frequency electric power supplying part 300 comprises three stacked boxes 324, 308, 310, and that a high-frequency electric power source 310 and a matching unit 328 are contained in separate boxes. (Figures 3 and 4)

It would have been obvious to one of ordinary skill in the art, in view of the teachings of Fischer et al., to modify the apparatus taught by Collins et al. and Suemasa

et al. to provide at least three stacked boxes to separately contain each of the first high-frequency electric power source, the first matching unit, and the second matching unit. The motivation for doing so, as taught by Fischer et al. (Column 4, Lines 49-60), would have been to ensure a single RF current return path to the high-frequency electric power source and to eliminate stray return currents by isolating the body of each RF matching network from the chassis of the RF shield box.

Whether the boxes are stacked "horizontally" or "vertically" is a matter of the frame of reference from which the apparatus taught by the combination of Collins et al., Suemasa et al., and Fischer et al. is observed, and is not considered to be a patentably distinct *structural difference* between the claimed invention and that taught by the cited prior art.

Response to Arguments

10. Applicant's arguments with respect to the pending claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

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mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maureen G. Arancibia whose telephone number is (571) 272-1219. The examiner can normally be reached on core hours of 10-5, Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571) 272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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